WE CLAIM AS OUR INVENTION:

1. A method for detecting cardiac rhythm abnormality, comprising the steps of:

providing a plurality of electrodes at a tip of a cardiac lead, which are electrically separated from each other;

placing said tip of said cardiac lead in contact with cardiac tissue so that all of said electrodes are simultaneously in substantially fixed contact with said cardiac tissue;

obtaining individual unipolar electrical signals from said cardiac tissue respectively via said electrodes, said unipolar signals exhibiting a time relationship relative to each other; and

analyzing said time relationship to obtain an analysis result and generating a signal indicating a cardiac rhythm abnormality dependent on said analysis result.

2. A method as claimed in claim 1 wherein the step of analyzing said time relationship comprises determining whether one of said unipolar signals was obtained with a time offset relative to another of said unipolar signals and, if so, generating said signal indicating a cardiac rhythm abnormality dependent on said time offset.

3. A method as claimed in claim 2 comprising generating said signal indicating a cardiac rhythm abnormality dependent on an absolute value of said time offset.

4. A method as claimed in claim 1 wherein the step of analyzing said time relationship comprises correlating one of said unipolar signals with another of said unipolar signals to obtain a correlation result, and generating said signal indicating a cardiac rhythm abnormality dependent on said correlation result.

5. A method as claimed in claim 4 wherein the step of correlating said one of said unipolar signals with another of said unipolar signals comprises the steps of:

defining a time window;

sampling said one of said unipolar signals and said another of said unipolar signals;

correlating samples in said time window of said one of said unipolar signals with samples in said time window of said another of said unipolar signals to obtain a first correlation result;

successively shifting said time window by one sample and, after each shift, again correlating the samples of said one of said unipolar signals in said time window with the samples of said another of said unipolar signals in said time window, to obtain a plurality of successive correlation results;

identifying a time offset between said one of said unipolar signals and said another of said unipolar signals by a number of samples associated with a shift of said time window which produced a highest correlation result among said first and successive correlation results; and

generating said signal indicating a cardiac rhythm abnormality dependent on said time offset.

6. A method as claimed in claim 1 wherein the step of analyzing said time relationship comprises identifying a sequence of occurrence of said individual unipolar electrical signals relative to each other, and generating said signal indicating a cardiac abnormality dependent on said sequence.

7. A method as claimed in claim 1 wherein the step of analyzing said time relationship comprises comparing respective times of occurrence of a selected characteristic of said individual unipolar electrical signals, selected from the group consisting of maximum slew rate and maximum negative derivative.

8. A method as claimed in claim 7 comprising defining a time window and comparing said times of occurrence in said time window, and comparing said times of occurrence to obtain said time relationship.

9. A method as claimed in claim 1 wherein the step of analyzing said time relationship comprises analyzing respective times at which the respective unipolar signals exceed a threshold value.

10. A method as claimed in claim 1 comprising the additional step of comparing at least one of said unipolar electrical signals to a threshold and generating said signal indicating a cardiac abnormality dependent on said analysis result and a relationship of said at least one of said unipolar signals to said threshold.

11. A method as claimed in claim 1 comprising forming individual electrodes in said plurality of electrodes as respective dot-like electrodes.

12. A method as claimed in claim 1 comprising arranging said plurality of electrodes at said one end of said cardiac lead with respective spacings between the electrodes which are substantially equal.

13. A method as claimed in claim 1 comprising disposing one of said electrodes at a center of said one end of said cardiac lead, and arranging a remainder of said electrodes symmetrically relative to said one of said electrodes.

14. A method as claimed in claim 1 comprising disposing one of said electrodes at a center of said one end of said cardiac lead, and arranging a remainder of said electrodes radially symmetrically relative to said one of said electrodes.

15. A method for detecting cardiac rhythm abnormality, comprising the steps of:

providing a plurality of electrodes a tip of a cardiac lead, which are electrically separated from each other;

placing said tip of said cardiac lead in contact with cardiac tissue so that all of said electrodes are simultaneously in substantially fixed contact with said cardiac tissue;

obtaining detections of individual unipolar electrical signals from said cardiac tissue respectively via said electrodes;

selecting a heartbeat representing a cardiac rhythm abnormality;

storing a detection pattern for the individual unipolar electrical signals obtained during said heartbeat as a template; and

subsequently obtaining further detections of individual unipolar electrical signals from said cardiac tissue respectively via said electrodes and comparing said subsequently obtained detections of unipolar signals to said stored template to obtain a comparison result, and generating a signal indicating a cardiac rhythm abnormality dependent on said comparison result.

16. A method as claimed in claim 15 wherein the step of comparing said subsequently obtained detections of unipolar signals to said template comprises conducting a pattern recognition between said subsequently obtained detections of unipolar signals and said template.

17. A method as claimed in claim 15 wherein the step of selecting a heartbeat representing a cardiac rhythm abnormality comprises selecting a plurality of different heartbeats respectively representing different cardiac rhythm abnormalities, and wherein the step of storing a detection pattern comprises storing a plurality of respective detection patterns for the individual unipolar electrical signals respectively obtained during said different heartbeats, as a plurality of templates respectively for said different cardiac rhythm abnormalities, and wherein the step of comparing said subsequently obtained detections of unipolar signals to said stored template comprises comparing said subsequently obtained detections of unipolar signals to the plurality of stored templates to obtain a comparison result indicating which of said templates said

said electrodes are simultaneously in substantially fixed contact with said cardiac tissue;

a QRS detector connected to said cardiac lead which obtains individual unipolar electrical signals from said cardiac tissue respectively via said electrodes, said unipolar signals exhibiting a time relationship relative to each other; and

an evaluation circuit which analyzes said time relationship to obtain an analysis result and which generates a signal indicating a cardiac rhythm abnormality dependent on said analysis result.

23. A cardiac rhythm abnormality detector as claimed in claim 22 wherein said evaluation circuit analyzes said time relationship to determine whether one of said unipolar signals was obtained with a time offset relative to another of said unipolar signals and, if so, generates said signal indicating a cardiac rhythm abnormality dependent on said time offset.

24. A cardiac rhythm abnormality detector as claimed in claim 23 wherein said evaluation circuit generates said signal indicating a cardiac rhythm abnormality dependent on an absolute value of said time offset.

25. A cardiac rhythm abnormality detector as claimed in claim 22 wherein said evaluation circuit analyzes said time relationship by correlating one of said unipolar signals with another of said unipolar signals to obtain a correlation result, and generates said signal indicating a cardiac rhythm abnormality dependent on said correlation result.

subsequently obtained detections of unipolar signals most closely resembles, and generating a signal indicating the respective cardiac rhythm abnormality, from among said plurality of cardiac rhythm abnormalities, dependent on said comparison result.

18. A method as claimed in claim 15 comprising forming individual electrodes in said plurality of electrodes as respective dot-like electrodes.

19. A method as claimed in claim 15 comprising arranging said plurality of electrodes at said one end of said cardiac lead with respective spacings between the electrodes which are substantially equal.

20. A method as claimed in claim 15 comprising disposing one of said electrodes at a center of said one end of said cardiac lead, and arranging a remainder of said electrodes symmetrically relative to said one of said electrodes.

21. A method as claimed in claim 15 comprising disposing one of said electrodes at a center of said one end of said cardiac lead, and arranging a remainder of said electrodes radially symmetrically relative to said one of said electrodes.

22. A cardiac rhythm abnormality detector, comprising:

a cardiac lead having a plurality of electrodes at a tip of said cardiac lead, which are electrically separated from each other, said tip of said cardiac lead being adapted for placement in contact with cardiac tissue so that all of

26. A cardiac rhythm abnormality detector as claimed in claim 25 wherein said evaluation circuit correlates said one of said unipolar signals with another of said unipolar signals by defining a time window, sampling said one of said unipolar signals and said another of said unipolar signals, correlating samples in said time window of said one of said unipolar signals with samples in said time window of said another of said unipolar signals to obtain a first correlation result, successively shifting said time window by one sample and, after each shift, again correlating the samples of said one of said unipolar signals in said time window with the samples of said another of said unipolar signals in said time window, to obtain a plurality of successive correlation results, identifying a time offset between said one of said unipolar signals and said another of said unipolar signals by a number of samples associated with a shift of said time window which produced a highest correlation result among said first and successive correlation results, and wherein said evaluation circuit generates said signal indicating a cardiac rhythm abnormality dependent on said time offset.

27. A cardiac rhythm abnormality detector as claimed in claim 22 wherein said evaluation circuit analyzes said time relationship by identifying a sequence of occurrence of said individual unipolar electrical signals relative to each other, and generates said signal indicating a cardiac abnormality dependent on said sequence.

28. A cardiac rhythm abnormality detector as claimed in claim 22 wherein said plurality of electrodes are respective dot-like electrodes.

29. A cardiac rhythm abnormality detector as claimed in claim 22 wherein said plurality of electrodes at said tip of said cardiac lead are disposed with respective spacings between the electrodes which are substantially equal.

30. A cardiac rhythm abnormality detector as claimed in claim 22 wherein one of said electrodes is disposed at a center of said tip of said cardiac lead, with a remainder of said electrodes disposed symmetrically relative to said one of said electrodes.

31. A cardiac rhythm abnormality detector as claimed in claim 23 wherein said remainder of said electrodes are disposed radially symmetrically relative to said one of said electrodes.

32. A cardiac rhythm abnormality detector, comprising:

a cardiac lead having a plurality of electrodes at a tip of said cardiac lead, which are electrically separated from each other, said tip of said cardiac lead being adapted for placement contact with cardiac tissue so that all of said electrodes are simultaneously in substantially fixed contact with said cardiac tissue;

a QRS detector connected to said cardiac lead which obtains individual unipolar electrical signals from said cardiac tissue respectively via said electrodes;

an extracorporeal programming device which allows selection of a heartbeat representing a cardiac rhythm abnormality by taking detections from the individual unipolar signals into account;

a template memory in which the detection pattern obtained at said cardiac rhythm abnormally is stored as a template;

said QRS detector subsequently obtaining further individual unipolar electrical signals from said cardiac tissue respectively via said electrodes; and

an evaluation circuit which compares said subsequently obtained unipolar signals to said stored template to obtain a comparison result, and generates a signal indicating a cardiac rhythm abnormality dependent on said comparison result.

33. A cardiac rhythm abnormality detector as claimed in claim 32 wherein said evaluation circuit compares said subsequently obtained unipolar signals to said template comprises conducting a pattern recognition between said subsequently obtained unipolar signals and said template.

34. A cardiac rhythm abnormality detector as claimed in claim 32 wherein said extracorporeal programming device allows selection of a plurality of different heartbeats respectively representing different cardiac rhythm abnormalities by taking detections from the individual unipolar signals into account, and wherein said template memory stores a plurality of detection patterns respectively obtained at said different cardiac rhythm abnormalities, and wherein said evaluation circuit compares said subsequently obtained unipolar signals to said plurality of stored templates to obtain a comparison result indicating which of said stored templates said subsequently obtained unipolar signals most closely resemble, and wherein said evaluation circuit generates a signal

indicating a type of cardiac rhythm abnormality, from among said plurality of cardiac rhythm abnormalities, dependent on said comparison result.

35. A cardiac rhythm abnormality detector as claimed in claim 32 comprising forming individual electrodes in said plurality of electrodes as respective dot-like electrodes.

36. A cardiac rhythm abnormality detector as claimed in claim 32 comprising arranging said plurality of electrodes at said one end of said cardiac lead with respective spacings between the electrodes which are substantially equal.

37. A cardiac rhythm abnormality detector as claimed in claim 32 comprising disposing one of said electrodes at a center of said one end of said cardiac lead, and arranging a remainder of said electrodes symmetrically relative to said one of said electrodes.

38. A cardiac rhythm abnormality detector as claimed in claim 32 comprising disposing one of said electrodes at a center of said one end of said cardiac lead, and arranging a remainder of said electrodes radially symmetrically relative to said one of said electrodes.

39. An implantable cardiac assist device comprising:

a cardiac lead having a plurality of electrodes at a tip of said cardiac lead, which are electrically separated from each other, said tip of said cardiac lead

being adapted for placement in contact with cardiac tissue so that all of said electrodes are simultaneously in substantially fixed contact with said cardiac tissue;

an electrical stimulation generator connected to said cardiac lead for delivering electrical stimulation to said cardiac tissue via said plurality of electrodes;

a control unit connected to said electrical stimulation generator;

a QRS detector which obtains individual unipolar electrical signals from said cardiac tissue respectively via said electrodes, said unipolar signals exhibiting a time relationship relative to each other; and

an evaluation circuit which analyzes said time relationship to obtain an analysis result and generates a signal indicating a cardiac rhythm abnormality dependent on said analysis result to said control unit for triggering delivery of said electrical stimulation by said electrical stimulation generator.

40. An implantable cardiac assist device as claimed in claim 39 wherein said evaluation circuit analyzes said time relationship to determine whether one of said unipolar signals was obtained with a time offset relative to another of said unipolar signals and, if so, generates said signal indicating a cardiac rhythm abnormality dependent on said time offset.

41. An implantable cardiac assist device as claimed in claim 40 wherein said evaluation circuit generates said signal indicating a cardiac rhythm abnormality dependent on an absolute value of said time offset.

42. An implantable cardiac assist device as claimed in claim 39 wherein said evaluation circuit analyzes said time relationship by correlating one of said unipolar signals with another of said unipolar signals to obtain a correlation result, and generates said signal indicating a cardiac rhythm abnormality dependent on said correlation result.

43. An implantable cardiac assist device as claimed in claim 42 wherein said evaluation circuit correlates said one of said unipolar signals with another of said unipolar signals by defining a time window, sampling said one of said unipolar signals and said another of said unipolar signals, correlating samples in said time window of said one of said unipolar signals with samples in said time window of said another of said unipolar signals to obtain a first correlation result, successively shifting said time window by one sample and, after each shift, again correlating the samples of said one of said unipolar signals in said time window with the samples of said another of said unipolar signals in said time window, to obtain a plurality of successive correlation results, identifying a time offset between said one of said unipolar signals and said another of said unipolar signals by a number of samples associated with a shift of said time window which produced a highest correlation result among said first and successive correlation results, and wherein said evaluation circuit generates said signal indicating a cardiac rhythm abnormality dependent on said time offset.

44. An implantable cardiac assist device as claimed in claim 39 wherein said evaluation circuit analyzes said time relationship by identifying a sequence of occurrence of said individual unipolar electrical signals relative to each other, and generates said signal indicating a cardiac abnormality dependent on said sequence.

45. An implantable cardiac assist device as claimed in claim 39 wherein said plurality of electrodes are respective dot-like electrodes.

46. An implantable cardiac assist device as claimed in claim 39 wherein said plurality of electrodes at said tip of said cardiac lead are disposed with respective spacings between the electrodes which are substantially equal.

47. An implantable cardiac assist device as claimed in claim 39 wherein one of said electrodes is disposed at a center of said tip of said cardiac lead, with a remainder of said electrodes disposed symmetrically relative to said one of said electrodes.

48. An implantable cardiac assist device as claimed in claim 39 wherein said remainder of said electrodes are disposed radially symmetrically relative to said one of said electrodes.

49. An implantable cardiac assist device comprising:

a cardiac lead having a plurality of electrodes at a tip of said cardiac lead, which are electrically separated from each other, said tip of said cardiac lead being adapted for placement in contact with cardiac tissue so that all of said electrodes are simultaneously in substantially fixed contact with said cardiac tissue;

an electrical stimulation generator connected to said cardiac lead for delivering electrical stimulation to said cardiac tissue via said plurality of electrodes;

a control unit connected to said electrical stimulation generator;

a QRS detector which obtains individual unipolar electrical signals from said cardiac tissue respectively via said electrodes, said unipolar signals exhibiting a time relationship relative to each other; and

an extracorporeal programmer which allows selection of a heartbeat representing a cardiac rhythm abnormality by taking detections from the individual unipolar signals into account;

a template memory in which the detection pattern obtained at said cardiac rhythm abnormality is stored as a template;

said QRS detector subsequently obtaining further individual unipolar electrical signals from said cardiac tissue respectively via said electrodes; and

an evaluation circuit which compares said subsequently obtained unipolar signals to said stored template to obtain a comparison result, and which generates a signal indicating a cardiac rhythm abnormality dependent on said comparison result to said control unit for triggering delivery of said electrical stimulation by said electrical stimulation generator.

50. An implantable cardiac assist device as claimed in claim 49 wherein said evaluation circuit compares said subsequently obtained unipolar signals to said template comprises conducting a pattern recognition between at least one of said subsequently obtained unipolar signals and said template.

51. An implantable cardiac assist device as claimed in claim 49 wherein said extracorporeal programming device allows selection of a plurality of different heartbeats

respectively representing different cardiac rhythm abnormalities by taking detections from the individual unipolar signals into account, and wherein said template memory stores a plurality of detection patterns respectively obtained at said different cardiac rhythm abnormalities, and wherein said evaluation circuit compares said subsequently obtained unipolar signals to said plurality of stored templates to obtain a comparison result indicating which of said stored templates said subsequently obtained unipolar signals most closely resemble, and wherein said evaluation circuit generates a signal indicating a type of cardiac rhythm abnormality, from among said plurality of cardiac rhythm abnormalities, dependent on said comparison result.

52. An implantable cardiac assist device as claimed in claim 49 comprising forming individual electrodes in said plurality of electrodes as respective dot-like electrodes.

53. An implantable cardiac assist device as claimed in claim 49 comprising arranging said plurality of electrodes at said one end of said cardiac lead with respective spacings between the electrodes which are substantially equal.

54. An implantable cardiac assist device as claimed in claim 49 comprising disposing one of said electrodes at a center of said one end of said cardiac lead, and arranging a remainder of said electrodes symmetrically relative to said one of said electrodes.

55. An implantable cardiac assist device as claimed in claim 49 comprising disposing one of said electrodes at a center of said one end of said cardiac lead, and arranging a remainder of said electrodes radially symmetrically relative to said one of said electrodes.